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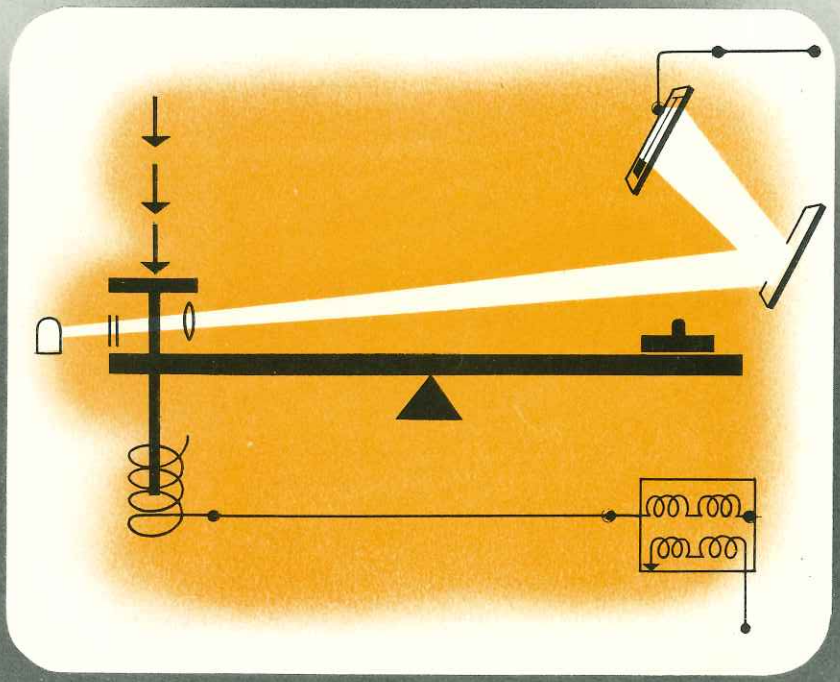
A REFERENCE MANUAL

FOR THE APPLICATION OF AUTOMATIC

WEIGHT SENSING



An idea stimulator showing how measurement of weight or force is applied for automatic control

Exact Weight SCALES
THE EXACT WEIGHT SCALE COMPANY
COLUMBUS 15, OHIO, U.S.A.

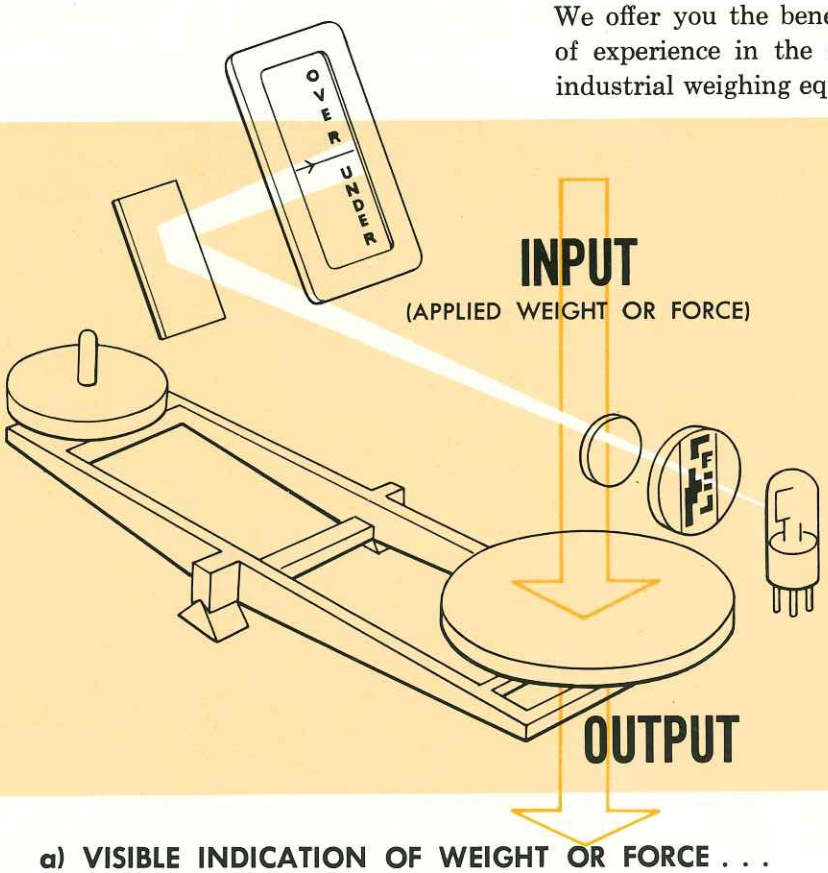
359/436

The purpose of this manual is to show how a principle of weight sensing or measurement of force can be utilized to perform a wide variety of control functions. This proven principle of automatic control is based on the use of the one-to-one (1:1) ratio predetermined weight scale and automatic electrical readout, a development of The Exact Weight Scale Company.

The flexibility and dependability of the Exact Weight principle make it adaptable for incorporation into almost any type of machine where precise control is a part of the function. Exact Weight controls are being used in machines for packaging of foods and chemicals, metalworking, textiles; equipment for cost and quality control; and weigh feeders for plastics injection molding.

The diagrams on the following pages show only representative applications and by no means include all the control possibilities available with the Exact Weight principle. Our engineers will be glad to make recommendations for the most economical solution to your specific weighing or control problem.

We offer you the benefit of more than 45 years of experience in the designing and building of industrial weighing equipment.



a) VISIBLE INDICATION OF WEIGHT OR FORCE . . .

b) CONVERSION of weight measurements into electrical output signals for:

1) **CLASSIFYING** or sorting by weight groups.
2) **RECORDING** weight data.
3) **IMPRINTING** weight data.
4) **COUNTING** by weight.
5) **ACTUATING** signals, audible or visual.
6) **OPERATING** key punch equipment.
7) **CONTROLLING** machine operational functions, processing equipment and handling mechanisms.

THE EXACT WEIGHT PRINCIPLE

The Exact Weight principle consists essentially of a precision weight sensing device (an even-balance lever system) with a transducer (optional types) for converting lever movement into an electrical signal, referred to as readout. Shadograph® weight indication is provided by a beam of light directed through an indicator with a binary coded reticle and onto a ground glass dial.

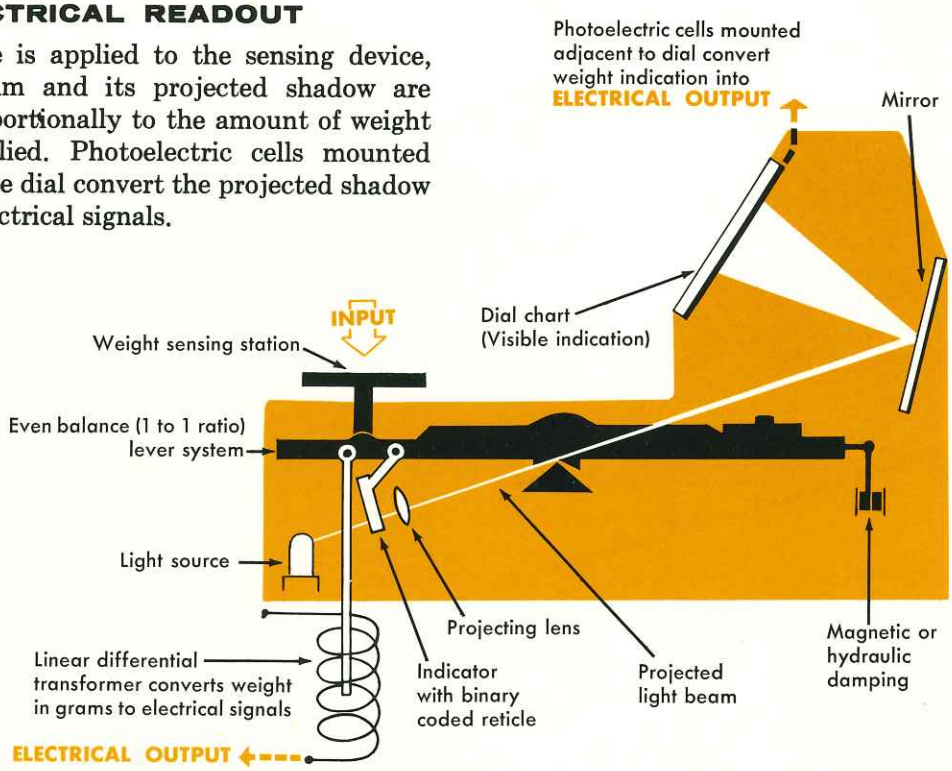
OPTOELECTRICAL READOUT

When a force is applied to the sensing device, the light beam and its projected shadow are deflected proportionally to the amount of weight or force applied. Photoelectric cells mounted adjacent to the dial convert the projected shadow travel into electrical signals.

As an alternate source of signal output, a linear differential transformer can be utilized as shown in the diagram below.

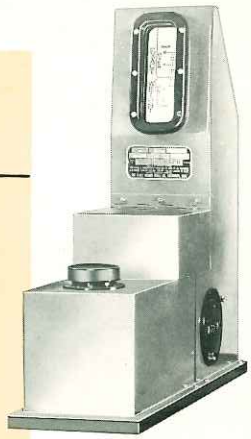
The output signals, electronically amplified, can be used to perform an almost endless number of control functions. And the control can be both more exact and unfailing than human hands or judgment. And faster.

®SHADOGRAPH is the registered trade mark of THE EXACT WEIGHT SCALE COMPANY.



Range of Shadograph Scale capacities and sensitivities

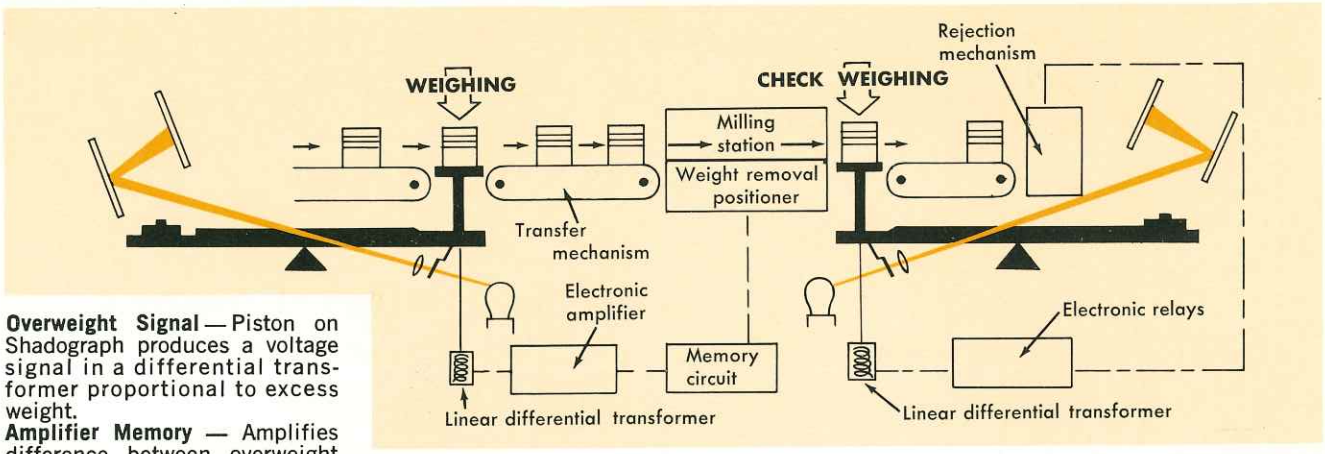
SCALE CAPACITY	VISIBLE SENSITIVITY ON SHADOGRAPH INDICATOR	SENSITIVITY OF PHOTOELECTRIC CELL CONTROL
2000 Milligrams	1 Milligram	1/2 Milligram
50 Grams, or 750 Grains	12 Milligrams, or 1/5 Grain	6 Milligrams
4 Ounces, or 100 Grams, or 1500 Grains	1/500 Ounce, or 50 Milligrams, or 1 Grain	1/2 Grain
8 Ounces, or 200 Grams, or 3000 Grains	1/250 Ounce, or 100 Milligrams, or 2 Grains	1 Grain
1 Pound, or 500 Grams	1/160 Ounce, or 175 Milligrams	1/320 Ounce
3 Pounds, or 1500 Grams	1/80 Ounce, or 350 Milligrams	1/160 Ounce
6 Pounds, or 3 Kilos	1/80 Ounce, or 350 Milligrams	1/160 Ounce
12 Pounds, or 5 Kilos	1/60 Ounce, or 1/2 Gram	1/120 Ounce
22 Pounds, or 10 Kilos	1/40 Ounce, or 3/4 Gram	1/80 Ounce
75 Pounds, or 35 Kilos	1/16 Ounce, or 2 Grams	1/32 Ounce
100 Pounds	1/4 Ounce	1/8 Ounce



The Shadograph is available in 35 models.

CONTROL OF MACHINE OPERATIONS

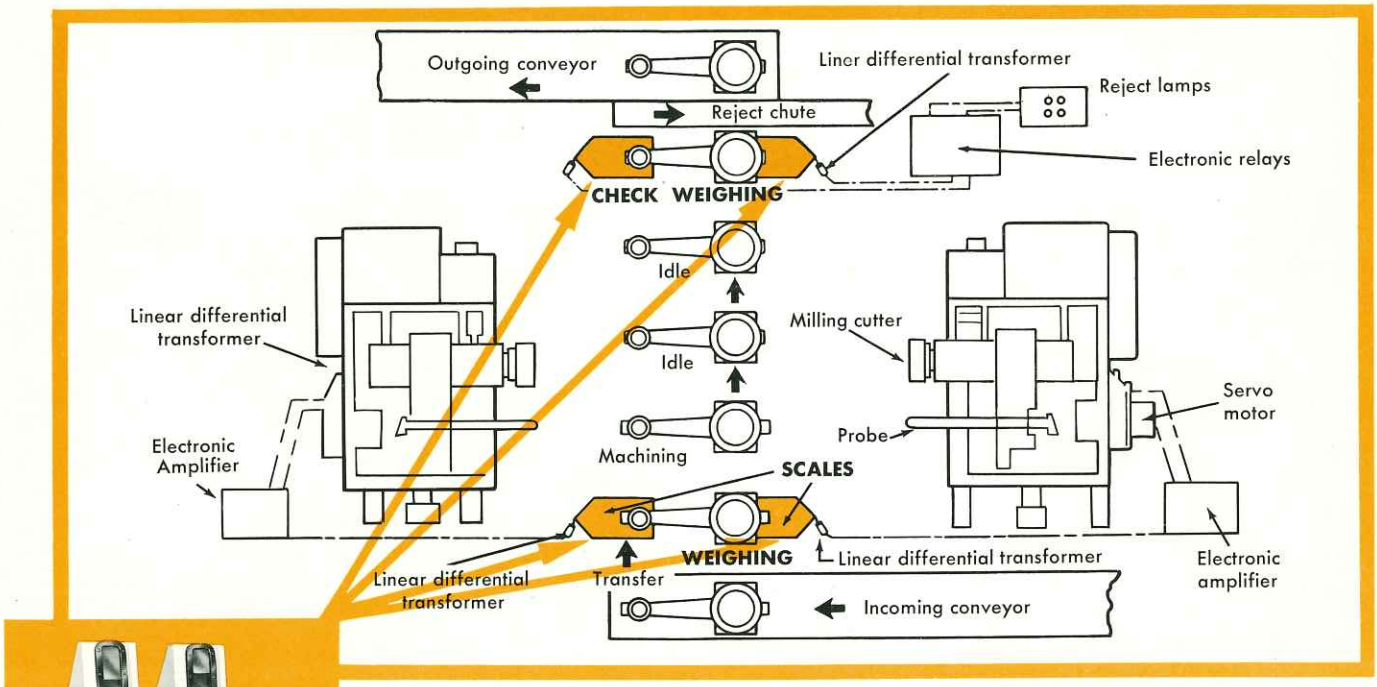
utilizing linear differential transformers



Overweight Signal — Piston on Shadograph produces a voltage signal in a differential transformer proportional to excess weight.
Amplifier Memory — Amplifies difference between overweight signal and memory signal, drives servomotor until difference is zero.
Memory Unit — Retains over weight-voltage signal and allows depth of cut to be set while piston indexes.
Weight-Removal Positioner — Sets wedge stop which determines depth of cut.

EXAMPLE NO. 1.

Diagram showing the operating principle of a machine that automatically mills aluminum pistons to within plus or minus two grams of specified weight. A Shadograph Scale first weighs the piston and the data is stored in an electronic memory circuit. When the piston reaches the milling station, electronic controls set up the work and position the cutter which removes the correct amount of stock. A second Shadograph Scale checkweighs the finished piece.



EXAMPLE NO. 2.

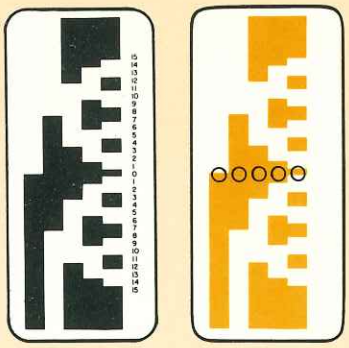
In-line transfer machine for weight standardizing and de-burring connecting rods. Workpieces are positioned automatically on twin Shadograph Scales and both ends are independently weighed. Differential transformers convert weight difference (over and under standard weight) in grams to electrical signals, then to depth of cut in inches. After milling, finished rods are checked by second twin Shadograph Scales; rods outside a tolerance of plus or minus two grams at either end are automatically rejected.

SORTING AND CLASSIFYING

items by weight groups

In this application of the Exact Weight principle, photocells are employed to produce electrical signals in accordance with predetermined weight groupings. These output signals automatically control the sorting or classifying mechanism as well as many other operational functions, some of which are shown in the diagram below. Items are sorted into correct weight groups, or over or under, within the predetermined limits. Up to 128 classifications can be obtained with accuracies compatible with the capacity of the scale, depending on operating speed and weight of items. See Page 3 for typical control sensitivities.

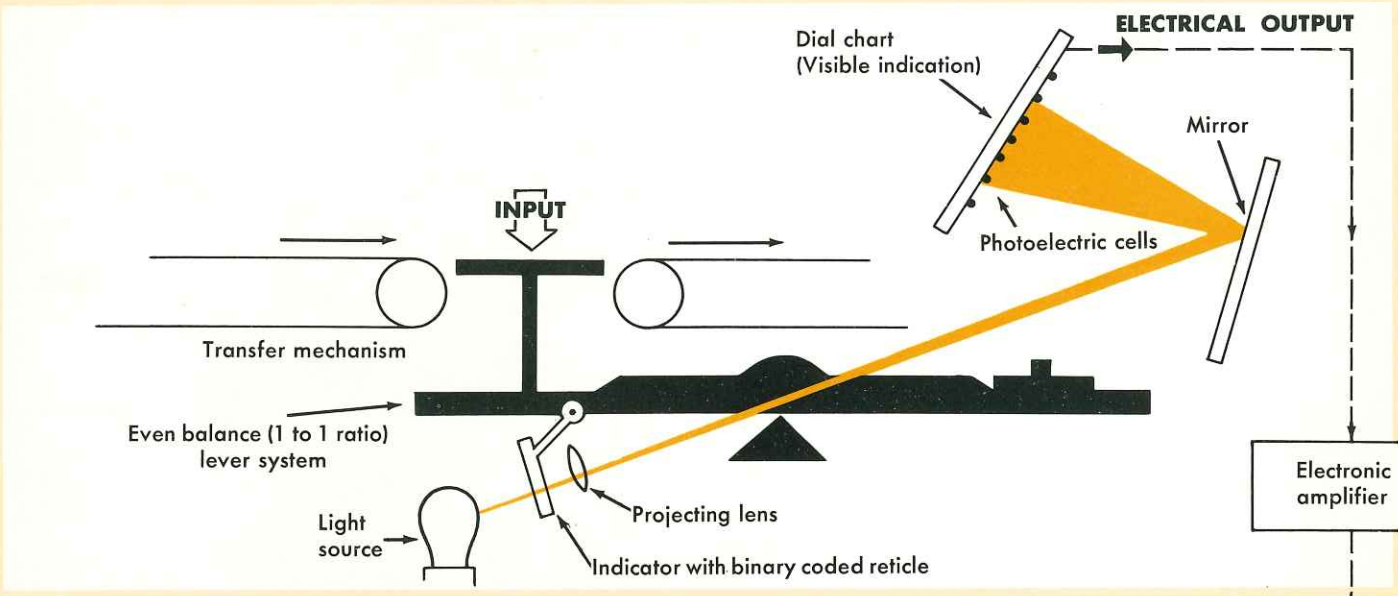
Complete units based on the Exact Weight principle of sorting and classifying by weight groups are custom engineered to meet particular requirements for handling items of any shape, and in capacities from two grams to 100 pounds.



Typical binary coded reticle.

Coded reticle projected on dial using five photocells.

Photocells are mounted adjacent to the visual dial. Used with a binary coded reticle, left, and utilizing from two to seven photocells, up to 128 weight classifications are possible.



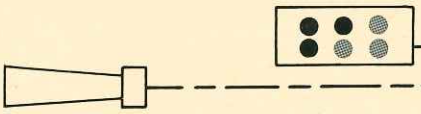
1) CLASSIFICATION OF ITEMS BY WEIGHT GROUPS

Power relay

2) OPERATION OF COUNTERS

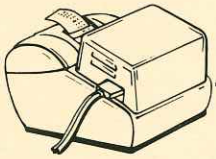
Power relay

3) ACTUATING SIGNALS, AUDIBLE AND VISUAL



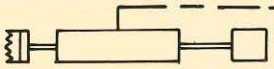
Power relay

4) RECORDING WEIGHT DATA



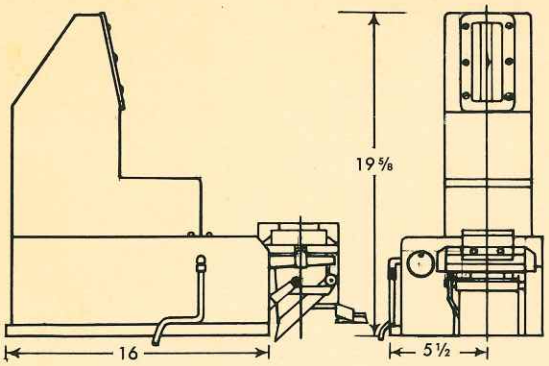
Power relay

5) CONTROLLING PROCESSING EQUIPMENT



Power relay

Other control functions as required

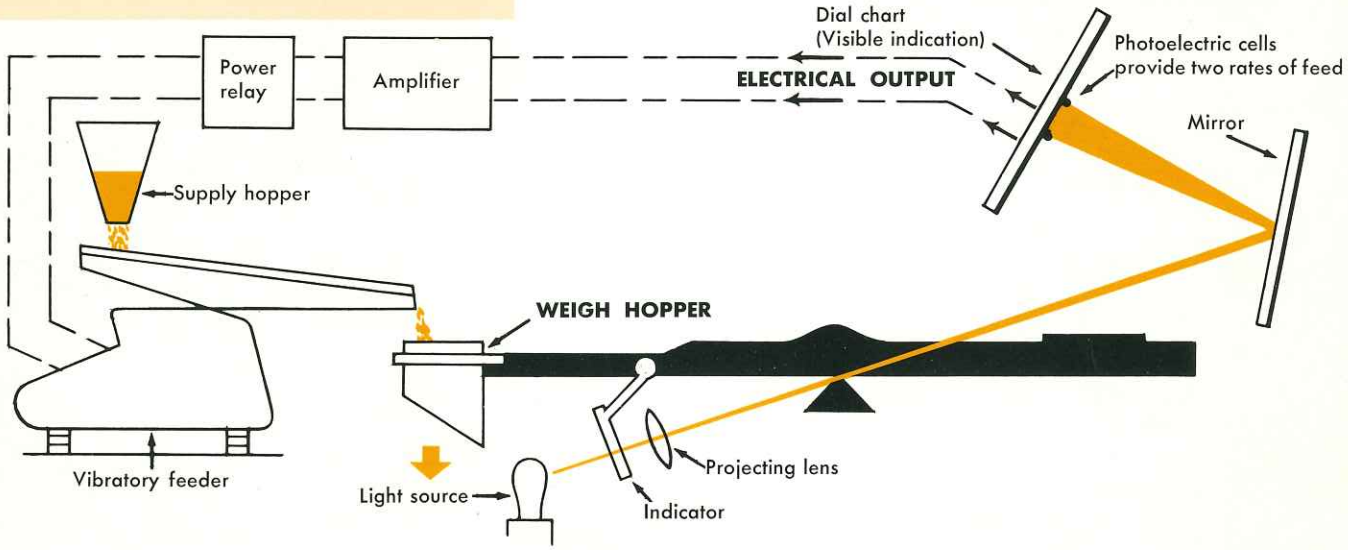


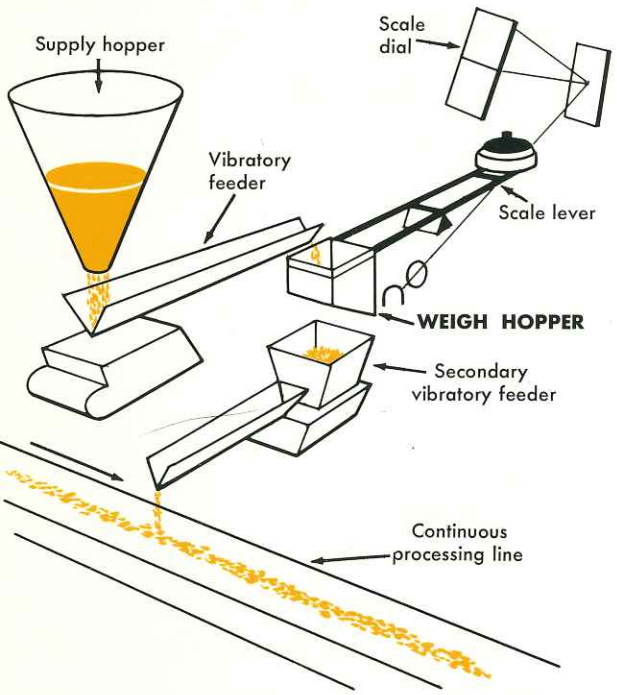
Max. Weight Capacity	Control Sensitivity	Indicator Travel	Weigh Hopper Capacity
50 grams	.05 grams	½" = 1 gram	5 cu. inches
100 grams	.075 grams	⅜" = 1 gram	10 cu. inches
250 grams	.10 grams	¼" = 1 gram	25 cu. inches
500 grams	.15 grams	⅛" = 1 gram	50 cu. inches

PRECISION NET WEIGHING

High precision for light-capacity net weighing of loose, free-flowing granular solids is attainable through application of an Exact Weight Scale equipped with cut-off controls. The net weigher, with the customer's feeding or handling equipment, is especially adaptable to incorporation in automatic filling or packaging machines. Exact Weight net weighing units of this type are engineered in a range of capacities to give maximum flexibility for special applications.

Dimensions, capacities and sensitivities are shown as examples. Other capacities available to 75 lbs.





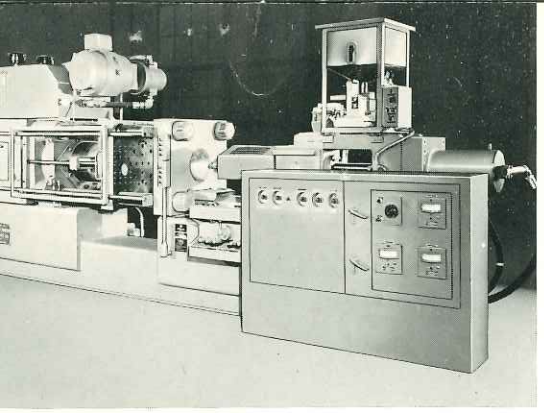
HIGH-PRECISION CONTINUOUS WEIGHING SYSTEM

Here is a system for controlling the flow and inserting dry additives into processing lines based on the precision net weighing principle above, using a secondary vibratory feeder. The accurately net weighed quantities are discharged at regular time intervals into the secondary feeder which, in turn, introduces the additive into the continuous processing line in a uniform flow.

This system has many applications in processing streams of chemicals, plastics, foods, fertilizers, feeds, seeds, drugs, powdered metals and similar products where high concentrate additives must be inserted in exacting quantities.

Similar equipment can be used for measuring the flow of product by accumulating predetermined batches and counting the number weighed in a time interval.

TYPICAL APPLICATIONS



PLASTICS — Automatic Weigh Feeder for plastics injection molding machine. The Hydraulic Press Manufacturing Co.

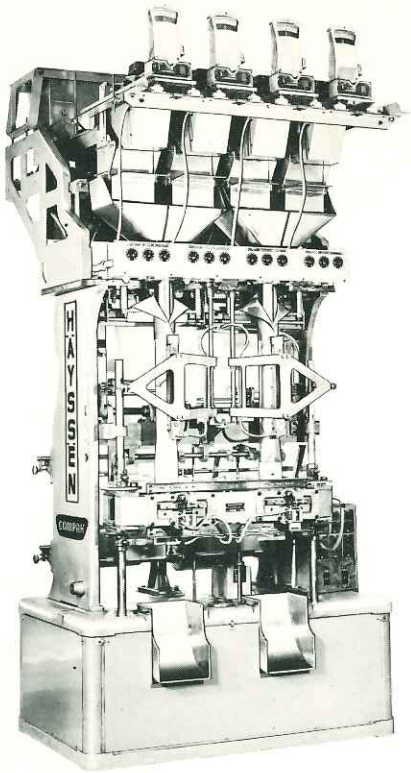
Shown on this page are some representative examples of automatic machines which incorporate Exact Weight equipment as a part of the original design. Every installation of Exact Weight equipment is job-engineered to meet specific needs. Consult us about your weighing problem. Our engineers will supply recommendations, and help you design the most economical application.

THE EXACT WEIGHT SCALE COMPANY
538 EAST TOWN STREET
COLUMBUS 15, OHIO

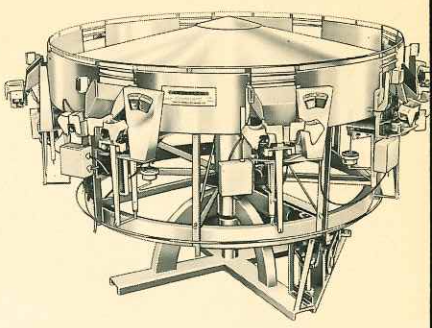
Exact Weight SCALES

OTHER EXACT WEIGHT O.E.M. CUSTOMERS

Aeroglide Corp.
American Machine & Foundry Co.
Dake Corp.
Dupps & Co.
Farrell-Birmingham Co.
Fellows Gear Shaper Co.
General Packaging Equipment Co.
Great Lakes Manufacturing Co.
H & H Machine Design Co.
Improved Machinery Co.
Industrial Specialties Co., Inc.
Johns Hydraulic, Ltd.
Lester Engineering Co.
Mercury Heat Sealing Co.
Morris Machine Tool Co.
National Automatic Tool Co.
Package Machinery Equipment Co.
Reed-Prentice Co.
Smico, Inc.
Snyder Tool & Engineering Co.
Tripak Machinery Service
Warner Swazey Co.

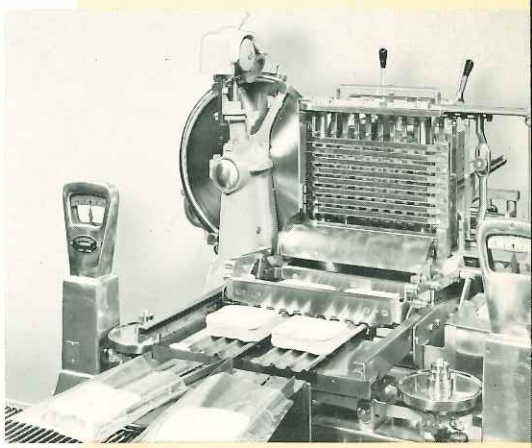


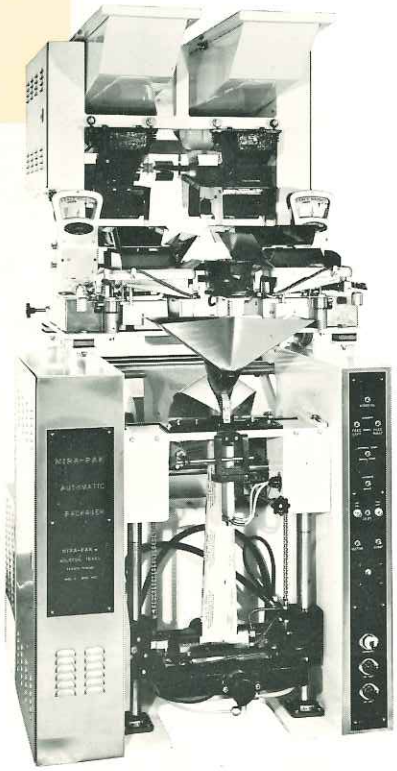
PACKAGING — Automatic Packaging Machine. Hayssen Packaging Machine Co.



PRODUCE PACKAGING—Automatic Weigh-Bagger. Troyer Manufacturing Co.

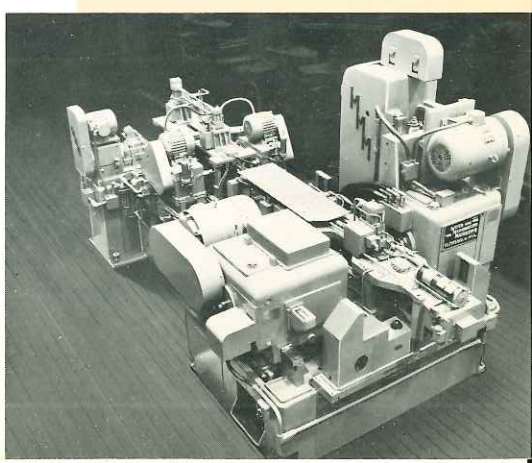
MEAT PRODUCTS — Below, Automatic Slicer-Scaler. U. S. Slicing Machine, Inc.





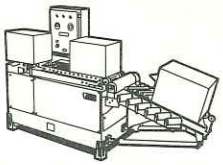
FOOD PACKAGING — Automatic Packager. Mira-Pak®, Inc.

MACHINE TOOLS — Below, In-Line Transfer Machine for weight standardizing and de-burring automotive connecting rods. The Motch & Merryweather Machinery Co.



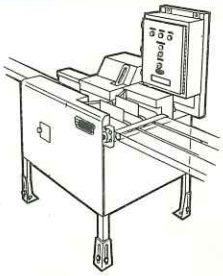
Exact Weight SCALES

Manufacturers of precision industrial weighing equipment for more than 45 years

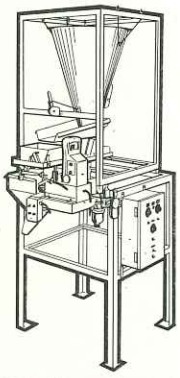


CASE AND BAG CHECKWEIGHER

BASIC WEIGHT CLASSIFIER



AUTOMATIC CHECKWEIGHERS



AUTOMATIC NET WEIGHING MACHINES

SHADOGRAPH SCALES 4200 SERIES

SHADOGRAPH SCALES 4100 SERIES

THE EXACT WEIGHT SCALE COMPANY
COLUMBUS 15, OHIO

EDWARD A. [illegible]WAY
36 WEST 25th ST. - BALTIMORE 18, MD.

LITHO IN U.S.A.